Integrity with Spiderweb Parallelism

Logistic Resilence with Interference Counting in Air/Sea-Ports

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Abstract

To counter occlusion, interference due to (water/metal) material and (truck drivers' personal privacy devices') radio in heavy traffic, security concerned air/sea-ports, optimal-degree-three, detection availability concerned spiderweb networks, SW(m,n) are incorporated with radio frequency identification (RFID) applications and sampled in the dedicated short range communications (DSRC) along critical passages, including those within logistic/vehicle architectures. Radial-ring configurations formed for spatial governing are proved with robustness; i.e., offering integrated responding resilence even if two paths of the network are destroyed. Besides, networks' laceability or connectivity can accommodate path grids to form an integrated cycles, which can offer fault-tolerance and sequential order to benefit large-scale and hierarchical managing operations. In addition, the parallelism of network path, i.e., mutually-independent-Hamiltonian-paths (MIHP), is applied to provide interference mitigation, parallel processing, traffic assessment, and dynamic authentication/ authorization. A network layout inherited with reliable mobile communications and spatial connections in area or air/sea-ports, e.g., Kaohsiung, is shown.

Keywords

Detection Avavailability; Hamiltonian; Mobile Business; Personal Privacy Device (PPD) ; Vehicle Architecture

Introduction

Just as military formations or defensive constructions, which naturally should count responding needs in all directions- i.e., radiantly, capitals or dominant cities of the world generally have radiant path configurations, probably through waterways, to develop efficient governing and defensible accessibilities. Hence, although a contemporary city or metropolitan can have multi-centers, the aforementioned configurations still exist more or less. Moreover, from small settlements to big cities, the traditional dominant cities generally can have relatively convenient accessibilities, and enough living resources, and then it can be developed step by step - inherently in a radial-ring configuration centered in the original settlement [Batty 2008; Batty and Longley, 1994; Keeble, 1969].

Well security ring formations or the defense-in-depth concept have been proclaimed [McNicholas, 2008] because more challenges can be met. It has been proved that radial-rings (spider-web) can have more fault-tolerance than single rings [Kao and Hsu, 2005a]. Due to technology development (e.g., stealth technology) and prevailing terrorism, which is a politically demanded issue for contemprary place development [Mansfeld and Pizam, 2006]; hence, preventing blind spots and fault-tolerant mechanism in surveillance systems or in its defensive radial ring spatial formations is important for air/sea-ports. Moreover, ring formations probably need be multi-centered; hence, well connection of several ring formations for adaptable hierarchical or integral operations is also the contemporary requirement.

The examination of casino surveillance systems, where more than eight cameras may be required to monitor a game table, helps us to recognize that the line-of-sight environment can be dynamic, and unexpected faults can exist. However, the traditional approach to traffic surveillance employs the use of only one or two cameras installed in the middle of a section of road; which cannot provide left- or right-side views of vehicles in the left- or right-hand traffic system. Thus, incidents can be caused, or accidents can be negatively developed due to sightline unavailability in detection systems [Hsu, 2008].

The cooperative function of parallel or dual surveillance is similar to that of the cooperation between the two eyes or two ears of a human being that compare images derived from (slightly) different positions or times. For invisible applications, for example, wireless spoofing or interference devices, including personal privacy devices (PPD, 2009; PNT, 2010) intentionally used by truck drivers to evade legal

wireless tracking in the global position system (GPS), already have shown adversary effects on the traffic control of airports and seaports (Chen et al., 2009; PNT, 2010; Pullen and Gao, 2012).

Literature Review

Hence, to promote (mobile) business development, integrated trip tracking in order to better serve passengers, freights via wireless communications, including radiant frequency identification (RFID) technologies featured with security, integrity, is tied much importance in air/sea-port cities (Ashford, 2011). After briefly reviewing recent achievements, this paper proposes an approach, which uses existing or relatively low-layer equipment (Chen et al., 2009; Malik et al., 2012), yet with detection availability, maintainability, infrastructural (standard regulation) regularity concerns – especifically on underground, highly (water, metal) interfered, mutimodal traffic (probably having bicycles like Amsterdam), and congested locations.

For those public spaces, personal privacy is considered as either a personal factor for reasonably choosing their personal communication devices (Wicker, 2012) or a factor affecting public safety (Pullen and Gao, 2012). For the personal factor, the adaptabilityto assign authorization/authentication appropriate to be considered, has been featured in our proposed networks. For public safety, countering interference should be considered in the infrastructure, which may not be used only for truck drivers with PPD (Pullen and Gao, 2012). Moreover, using relatively low-layer equipment, probably incorporated with other mathematical techniques (Zhang et al., 2012) to pervasively benefit the prevention of interference issues or promotion in wireless communication integrity is intended is this paper.

Dual surveillance similar to that used to counter sightline unavailability, can help counter material interference (information transmission covered by materials like metal or water) using a method as well as deal with frequency interference or multipath effects bymeans of the analysis of acquired data related to different positions and time sequence using parallel or mutually independent Hamiltonian paths (see MIHP in next section) [Hsu, 2012a]. In addition, a series of such dual-surveillance could be located along the path at blind-spot concerned positions to get parallel and thorough recordings as the diagnostic tool. As to waterways which have more adversary conditions due to water's radio interference possibilities, countering boat collisions, smugglings, and pirate ships need to be actively prepared [Wong and Yip, 2012; Allen, 2010; Fritteli, 2008]. In other words, dual-surveillance based surveillance-information networks are worthy of being concerned for busy waterways; however, their detection devices may be considered floatable [Getter, 2012; Knox and Douglass, 2010].

A mathematical,optimal-degree, dual-surveillance-based spider-web network prototype, SW(m,n) is proposed for air/sea-ports, dominant city centers, and their neighboring areas for both wireless/ heterogeneous surveillance-information networks on paths (FIG.1). Such a surveillance-information network that has fault tolerance and an order (properties of 1-edge Hamiltonian and 1p-Hamiltonian, see next section) to promote maintenance efficiency/ effectiveness is addressed. Such networks can be adaptive to accommodate surveillance modes such as surveillance of both forward and backward directions and to accommodate the surveillance-information operation when one lane of a path is under maintenance. Moreover, such networks are scalable; i.e., they have the flexibility to extend a path or survey (water) area to meet future requirements capacity enlargement or blind-spot prevention surveillance in congested environments.

Mathematical Preliminaries

Communication networks are usually illustrated by graphs in which nodes represent processors and edges represent links between processors. Let G=(V,E) be a graph if V is a finite set and E is a subset of $\{(a,b) \mid (a,b)$ is an unordered pair of V$\}$. A path is delimited by $(x_0,x_1,x_2,\ldots x_{n-1})$. A path is called a Hamiltonian path if its nodes are distinct and span V. A cycle is a path of at least three nodes such that the first node is the same as the last node. A cycle is called Hamiltonian cycle or Hamiltonian if its nodes are distinct except for the first node and the last node, and if they span V span *V* (Hsu and Lin, 2008).

A bipartite graph G = (V,E) is a graph such that $V=A\cup B$ and E is a subset of $\{(a,b) \mid a\in A$ and $b\in B\}$; if G-F remains Hamiltonian for any F={a,b} with $a\in A$ and $b\in B$, then G is 1_p-Hamiltonian. A graph G is 1-edge

Hamiltonian if G-e is Hamiltonian for any $e \in E$; moreover, if there is a Hamiltonian path between any pair of nodes {c,d} with $c \in A$ and $d \in B$, then the bipartite graph G is Hamiltonian laceable.

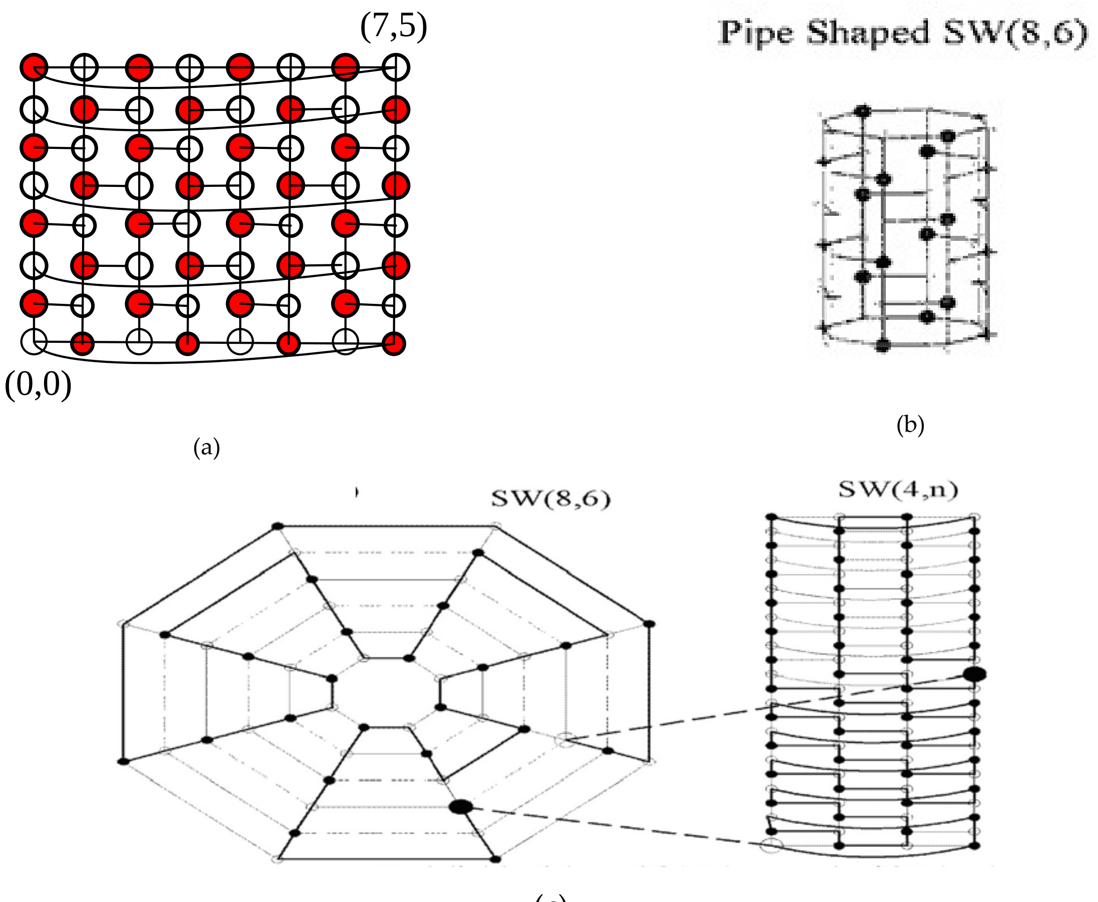
The bipartite spider web network, SW(m,n), is the graph with the node set $\{(i,j) \mid 0 \leq i<m, 0 \leq j<n\}$, where m and n are greater than or equal to 4, even integers such as (i,j) and (k,l) are adjacent if they satisfy one of the following conditions: (1) i=k and $j=l \pm 1$; (2) j=l and $k=i+1 (\bmod\ m)$ if i+j is odd or j=n-1; (3) j=l, $k=i-1 (\bmod\ m)$ if i+j is even or j=0. SW*(m,n)* (FIG.1) is proved to be 1-edge Hamiltonian and 1_p-Hamiltonian [Kao & Hsu, 2005a]. Therefore, the fault-tolerance engaged in is systematically based. Moreover, SW(m,n) are Hamiltonian laceable [Kao & Hsu, 2005b], see FIG. 1(a).

The number of links connecting a node is called the degree; and networks regularly having smaller degree are generally economic [Stojmenovic, 1997]. Two Hamiltonian paths, $P_1=(u_1, u_2,\ldots,u_{n(G)})$ and $P_2=(v_1,v_2,\ldots,v_{n(G)})$ of G from u to v are independent if $u=u_1=v_1$, $v=u_{n(G)}= v_{n(G)}$, and $u_i \neq v_i$ for every $1<i<n(G)$. A set of Hamiltonian paths, $\{P_1,P_2,\ldots,P_k\}$, of G from u to v, is mutually independent if any two distinct paths in the set are independent from u to v [Teng et al., 2006]. It was found that SW(m,n) has the performance of at least two mutually independent Hamiltonian paths between any pair of bipartite nodes [Hsu, 2012a] (FiG. 2).

Significance

Effective Connecting Scattered Tactical Resources

Just as the advanced ground radar systems used in airports to cope with blind spots, scattered land blocks can be integrally used for a common use if they can be well monitored and controlled to fit operational requirements. For tourism development, the abundant culture resources in port cities generally can be connected via their potential or adaptable radial-ring road systems [Hsu, 2012c]. Hence, in addition to security operation, more caring services can be provided through the proposed communication networks by the authority.



(a) (b) (c)

FIG. 1SPIDER-WEB NETWORK – (A). MATHEMATICAL (PLANNAR) PRESENTATION OF SW(8,6), (B). PIPE-SHAPE OF SW(8,6), (C). HAMILTONIAN LACEABILITY OF SW(M,N)

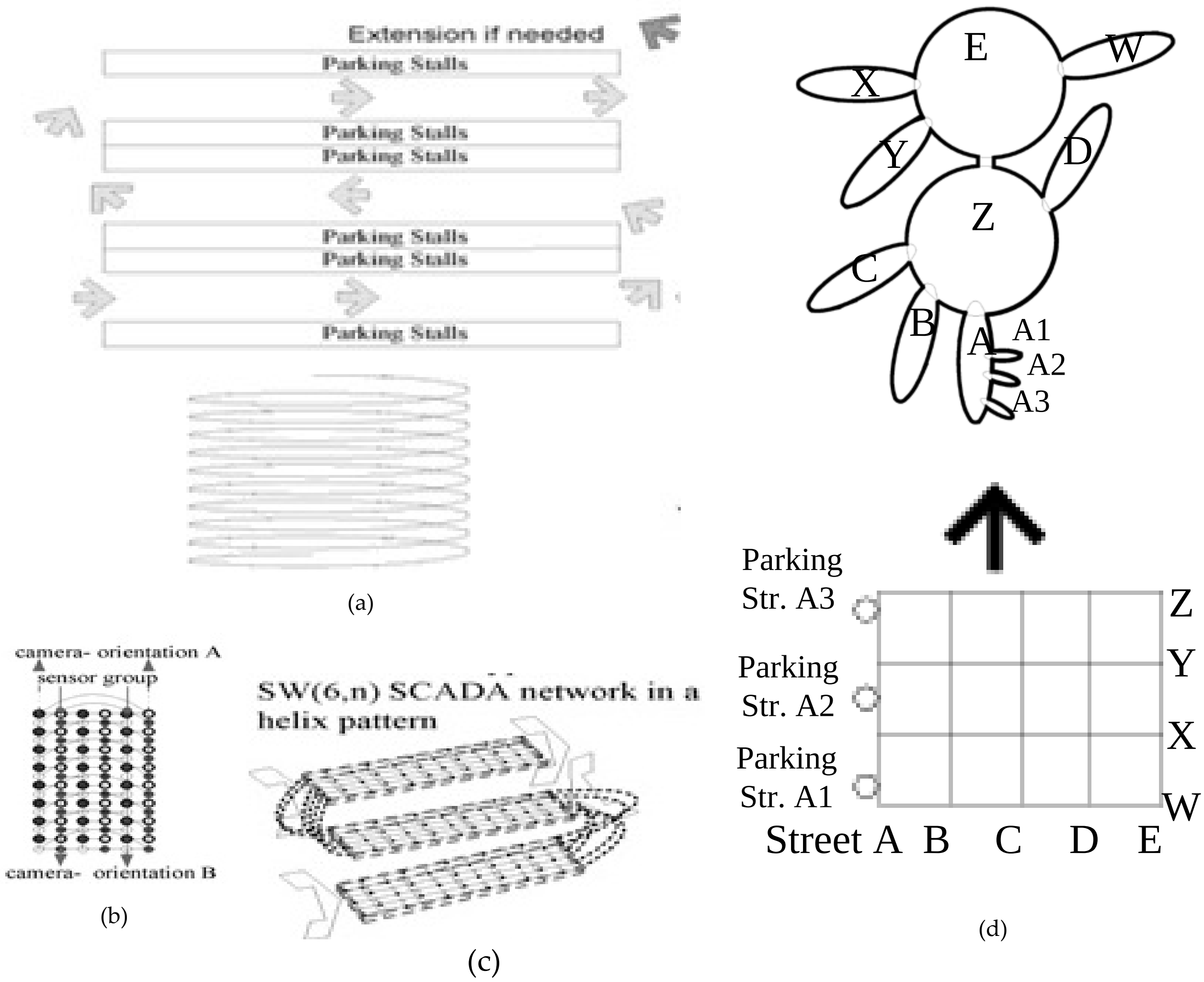


FIG. 2 INTEGRATE SW(m,n) W. VEHICLE CIRCULATION. (a). RATIONAL CIRCULATION FOR WAYFINDING AND MAINTENANCe; (b). NODE ADAPTATION; (c). WIDTH ADAPTATION; (d). AREA BASED INTEGRATION. (Hsu, 2006)

Similar to military formations, defensive constructions, dominant cities of the world, including Beijing, London, Paris, Moscow, and Washington D.C., generally have radiant path configurations, probably through waterways, to develop efficient governing and defensible accessibilities. Although a contemporary city or metropolitan can have multi-centers, the aforementioned configurations still exist more or less. Moreover, from small settlements to big cities, the traditional dominant cities generally can have relatively convenient accessibilities, and enough living resources, and then it can be developed step by step - inherently in a radial-ring configuration centered in the original settlement (Keeble, 1969).

By inherent but real radial-ring motion flow, a grid urban pattern can enlarge its original scope of urban activities. In this perspective, a grid pattern can rationally be adapted to a radial-ring pattern; further, the grid can be illustrated to be the radial-ring (Keeble, 1969; Hsu, 2008). It is found that bipartite spider-web networks have mathematical laceability (connectivity) to sustain the ring performance of connected spider-web networks. Such connected rings are featureed with hierarchical management, sequential order for maintenance, and fault-tolerance.

The proposed radial-ring configured DSRC network prototype is made of spider-web networks; in other words, it is a spider-web (radial-ring) network of spider-web (radial-ring) networks. Furthermore, just as cities may be multi-centered, flexible amount of radial-rings of radial rings can be integrated or sub-divided (e.g., in a campus site, a large vehicle architecture); i.e., fractal. Due to the limitation of land resources, if scattered land resources can be more effectively managed for certain regulated usages, such as free-taxed production areas, prototyped networks

can get more flexibility, reliability, and service quality in management on restricted-use and the sustainability of future development.

In another perspective, historical heritage and other cultural/natural assets are often resources for tourism development. However, such assets may affect flows of planned spatial development and often be sacrificed. Except for the adoption of underground or overpass construction technologies, such assets can be more carefully dealt with, or kept if the proposed information network prototype can be applied to avoid adversary effects on traffic flows and spatial development - i.e., proposed information networks can be well connected either underground or overpass to help traffic well moved.

Supporting Network Performance with Parallelism

False detections may happen for many reasons such as multipath effects, node or link (transmission) faults, and a combination of the two. After configuring adaptable dual-surveillance as a basic detection-availability platform, systematic fault-tolerance, connectivity and management efficiency enhance detection-availability. Furthermore, a diagnostic performance MIHP can be established to analyze time-series related adversary conditions using independent, alternative, time-series recordings for data mining or diagnosing problems. This is similar to physicians employing independent alternatives and time-series records to diagnose a disease. In addition, the MIHP parallelism can offer inherent dynamic authorization/authentication during routine operations when alternative sequences own corresponding meanings [Lee et al., 2005; Hsu, 2008].

Sustaining Resilient Area-Based Management System

The Hamiltonian laceability can help flexibly to integrate individual surveillance-information networks along paths, including interior paths, to area-based surveillance-information networks. If such networks can be adaptive to an inherent “spider-web” skeleton (FIG. 3), then they can have the performance of spider-web networks; i.e., offering responding capabilities even after two paths of a surveillance-information network have been seriously compromised.

In transportation, we need to make long-term infrastructure decision in general (Sussman, 2000, 4). In another perspective, right decision to adapt exiting land-use condition to satisfy new demand is also needed (Tumlin, 2012). By compution, communication technologies, many spaces are adaptive to new uses. Specifically, the activities held in traditional assembly halls can be placed in scattered spaces if in need.

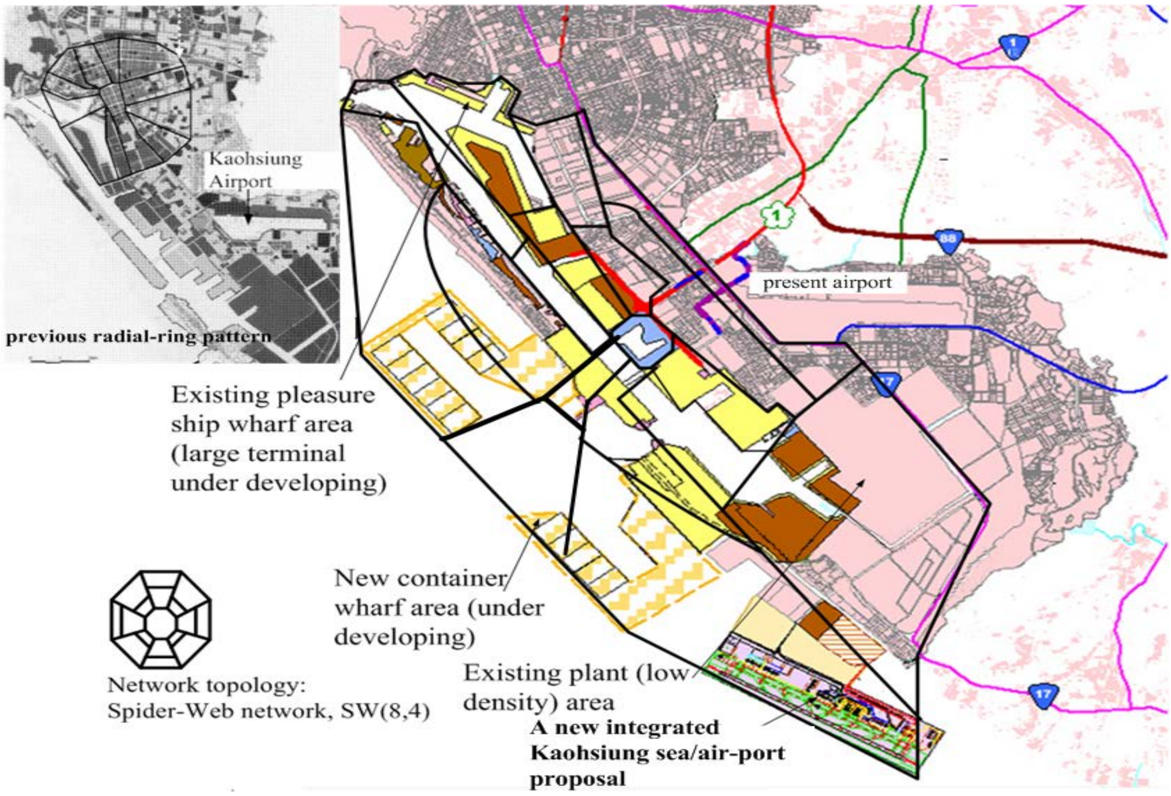


FIG. 3. A NETWORK PROPOSAL FOR KAOHSIUNG AIR/SEA-PORT AREA[MOTT-MACDONALD, 2009; HSU, 2012B]- SUBNETWORKS NOT-SHOWN.

However, the qualities such as reliability, integrity, ubiquity of those compution, video-audio technologies are important, which has already been considered in the aforementioned network prototype.

Senior citizens represent one of the fastest-growing segments of the population. Therefore, it is important to provide demand-responsive environments in order to comfortably accommodate elderly, disabled individuals (Chrest et al., 2001; Wachs, 2001) and foreigners. Hence, the aforementioned, highly reliable security-information networks can offer continuous and thoughtful protection for travelers. It is vital to make travelers and transportation customers safety and accessible when planning future urban infrastructure with caring surveillance-information service networks.

Conclusions

Nowadays, the promotion of pervasive communication is a strategyto develop regional and human welfare. The quality of communication networks, such as systematic reliability and integrity, need to be addressed. More specifically, such quality includes networks' fault tolerance, working orders for maintenance or inspection, detection availability for real-time monitoring, wireless security or privacy, and systematic diagnosability to counter false alarms or compromised information acquisition caused by noise or the multipath effects of radios, which can be significantly affected by metal, water and radio interference attacks.

Radial-rings (spider-web) can have more fault-tolerance than single rings. Due to technology development and the prevalence of terrorism, to devise occlusion on the prevention of interference mitigation, and fault-tolerant mechanism in surveillance-information service systems in defensive radial-ring spatial formations is considered worthwhile for air/sea-ports. Using more sensors to strengthen detection availability can be preactical in securing function and keeping acceptable appearance, due to the affordability and invisibility of sensors.

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